3.8 What is a local linear approximation? Or a differential?

2014-11-06 day 50
fire drill spot: 18C

"Formula 1" pg 227

$f(x) \approx f(x_0) + f'(x_0)(x - x_0)$

$f(x)$ for values of x that are "close enough" to x_0

$y =$ restatement of the eqn of a tangent line at x_0

1a) (1a to $y = x^3$ at $x_0 = 1$ $\quad f(x) = x^3 = y$

→ $f(x_0 = 1) = (1)^3 = 1$

→ $f'(x_0 = 1) = f'(x)\big|_{x=1} = 3x^2\big|_{x=1} = 3(1)^2 = 3$

$f(x) \approx 1 + 3(x - 1)$

→ local linear approximation

x^3; pt$(1,1)$
$m = 3(1)^2 = 3$
$y - 1 = 3(x - 1)$
$+1 \quad +1$
$y = 1 + 3(x - 1)$

1b) $f(x) = x^3$; $x_0 = 1$

Formula 2

$f(x + \Delta x) \approx f(x) + f'(x)\Delta x$

$f(x + \Delta x) \approx 1 + 3(\Delta x)$

1c) $(1.02)^3$ using (a)

$f(x) \approx 1 + 3(x - 1)$

$f(1.02)$

$f(1.02) \approx 1 + 3(1.02 - 1)$
$= 1 + 3(.02) = 1.06$

$1.02^3 = 1.061208$

1c (using b)

$f(x + \Delta x) \approx f(x) + f'(x)(\Delta x)$

here: $x = 1$
$\Delta x = 1.02 - 1 = 0.02$

$f(1.02) \approx f(1) + f'(1)(0.02)$
$= 1 + 3(0.02) = 1.06$

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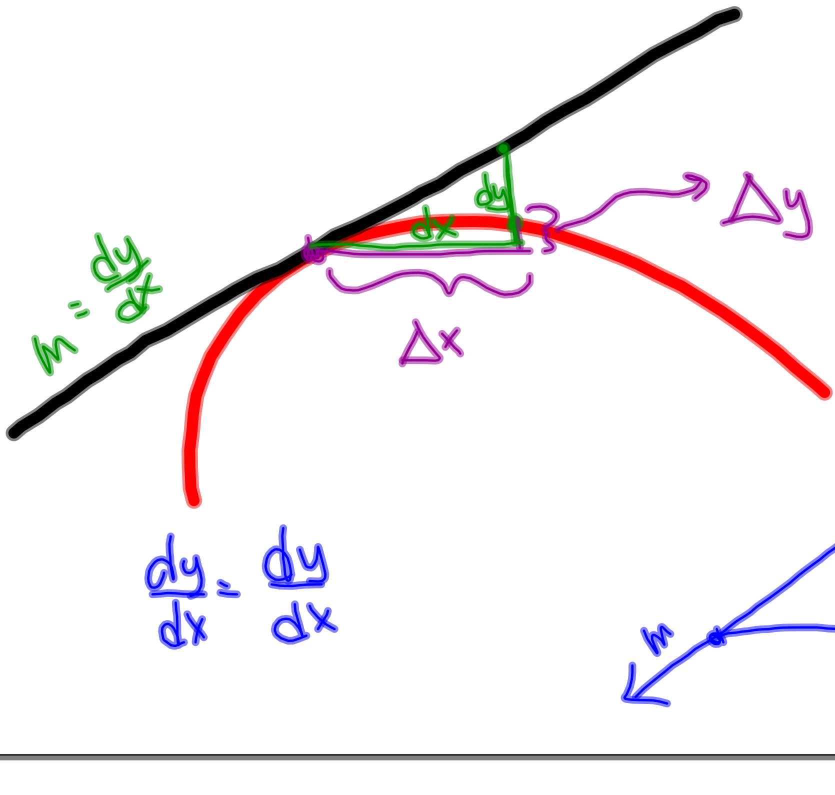
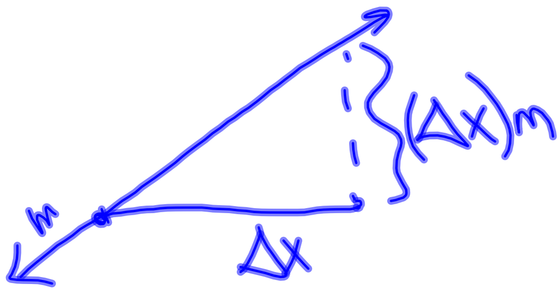
$\frac{dy}{dx}$ for 1st derivative

$\frac{\Delta y}{\Delta x} \to \frac{dy}{dx}$ denoting a qty "infinitesimally close"



$\frac{dy}{dx} = \frac{dy}{dx}$



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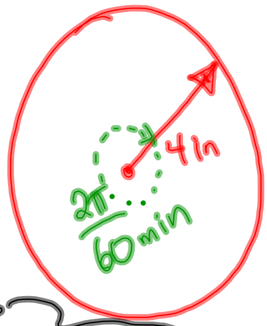
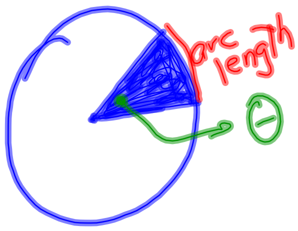
3.7/11)





degrees

θ	part of circle
360°	entire circle
180°	half
90°	$\frac{1}{4}$
60°	$\frac{1}{6}$
150°	$\frac{5}{12}$

radians

Area

area of entire circle: πr^2

$\frac{\text{area of piece of the circle}}{}$

$\left(\frac{\theta}{2\pi}\right)\pi r^2$

$\text{Area}_{\text{sector}} = \boxed{\frac{\theta r^2}{2}}$

$\frac{\text{sector arc length}}{\text{circumference}}$

$\left(\frac{\theta}{2\pi}\right)(2\pi r)$

sector arc length $= \theta r$

3.7/11

$A = \frac{\theta r^2}{2}$

$A = \frac{\theta(4)^2}{2}$

$= \frac{16}{2}\theta$

$\boxed{A = 8\theta}$ (2) eq^n always true

$\frac{dA}{dt} = 8\frac{d\theta}{dt}$ (3) derivative eq^n always true

$\frac{dA}{dt} = 8\left(\frac{2\pi}{60}\right)$ (4)

$= \frac{4\pi}{15}$ → $\frac{\text{sq in}}{\text{min}}$